Chapter Assessment

Choose the letter corresponding to the best answer.

1. Which of the following is/are true?
    a. The probability distribution of a statistic is known as a sampling distribution.
    b. The sampling distribution of $\bar{x}$ is normal whenever samples are random, selected from normal populations.
    c. The Central Limit Theorem states that the sampling distribution of $\bar{x}$ approaches the normal distribution whenever n is large.
    d. all of the above

For numbers 2 and 3, consider the following sampling distribution of $\bar{x}$ below.

$\bar{x}$	1	2	3	4	5	6	7
$p(\bar{x})$	$\frac{1}{16}$	$\frac{2}{16}$	$\frac{3}{16}$	____	$\frac{3}{16}$	$\frac{2}{16}$	$\frac{1}{16}$

2. Which of the following is/are true?
    a. $P(\bar{x} = 4) = \frac{4}{16}$
    c. $P(0.5 < \bar{x} < 2.5) = \frac{3}{16}$
    b. $P(\bar{x} > 5) = \frac{3}{16}$
    d. all of the above

3. Which of the following is/are true?
    a. $E(\bar{x}) = 4$
    c. $\text{Var}(\bar{x}) = 2.5$
    b. $\sigma_{\bar{x}} = 1.5811$
    d. all of the above

For numbers 4 and 5, consider the following.

A pharmaceutical company claims that the average time it takes to get relief after taking their pain reliever is 10 min with a standard deviation of 0.5 min. A random sample of 100 persons who have taken the pharmaceutical company's pain reliever is chosen.

4. Which of the following is/are true about the sampling distribution of $\bar{x}$?
    a. Its variance is 0.25
    c. It is normally distributed.
    b. Its mean is 10 min.
    d. all of the above

5. What is the standard error of the sampling distribution of $\bar{x}$?
    a. 0.5
    c. 0.005
    b. 0.05
    d. 0.0707

For numbers 6 and 7, consider the following.

A study was conducted to ascertain the stability of ascorbic acid in reconstituted frozen orange juice concentrate stored in a refrigerator for one week. Suppose it is known that the ascorbic acid per liter content is normally distributed with mean and standard deviation of 46 milligrams (mg) and 2.4 mg, respectively. A random sample of 36 frozen orange juice concentrate bottle was tested and the ascorbic acid per liter content of each bottle was measured.

6. Which of the following is/are true?
    a. The sampling distribution of $\bar{x}$ is normal even for sample sizes lower than 30.
    b. It is necessary to use the Central Limit Theorem to determine the sampling distribution of $\bar{x}$.
    c. The sampling distribution of $\bar{x}$ is approximately normal since the sample size is large.
    d. all of the above

7. What is the probability that the mean of the sampled frozen orange juice concentrate is at least 45 mg?
    a. .0062   c. .6615
    b. .3385   d. .9938

8. Which of the following is/are true?
    a. A higher level of confidence results in a longer confidence interval.
    b. Information provided by sample data is used in estimating the value/s of unknown population parameter/s.
    c. Point estimation is concerned with giving a value to unknown population parameter/s.
    d. all of the above

9. A random sample of ten public schools reported the following number of days that classes were suspended last school year because of typhoons: 11, 5, 5, 8, 7, 12, 9, 4, 10, and 12. Which of the following is/are true?
    a. The statistic $\bar{x}$ is an estimator of the true mean number of days classes were suspended last school year because of typhoons.
    b. An estimate of the true mean number of days classes were suspended last school year because of typhoons is 8.3.
    c. The formula of the margin of error that must be used in constructing a confidence interval for the mean number of days classes were suspended because of typhoon is $e = t_{\alpha/2(n-1)} \dfrac{s}{\sqrt{n}}$.
    d. all of the above

10. Fifty randomly selected undergraduate students of a certain university were asked if they listen to music while studying. Ten of them responded "yes." Which of the following is/are true?
    a. An estimate of the true proportion of undergraduate students in this university that listens to music while studying is 0.2.
    b. The statistic $\hat{p} = \dfrac{x}{n}$ is an estimator of the true proportion of undergraduate students in this university that listens to music while studying.
    c. An estimate of the true proportion of undergraduate students in this university that do not listen to music while studying is 0.8.
    d. all of the above

For numbers 11 to 13, consider the following.

To evaluate the morale of their employees, a manager decided to ask his/her employees to take a job satisfaction test. The scores are known to follow the normal distribution with a standard deviation of 24 points.

11. How large a sample should the manager take if he/she wants the estimate of true mean score of the employees not to differ by more than 5 points with 95% confidence?
    a. 4
    b. 63
    c. 89
    d. 50 981

12. Due to time constraints, the manager decided to take a random sample of 36 employees. If a 99% confidence interval is desired for the true mean score of the employees in the job satisfaction test, which formula of the margin of error should the manager use?
    a. $e = Z_{\alpha/2} \dfrac{\sigma}{\sqrt{n}}$
    c. $e = Z_{\alpha/2} \dfrac{s}{\sqrt{n}}$
    b. $e = t_{\alpha/2(n-1)} \dfrac{s}{\sqrt{n}}$
    d. $e = Z_{\alpha/2} \sqrt{\dfrac{\hat{p}\hat{q}}{n}}$

13. A 99% confidence interval for the true mean score of the employees in the job satisfaction test is from 77.7 to 98.3 points. The morale of employees would be a problem if the average score is found to be at most 75 points. Which of the following is/are true?
    a. The manager should worry since the estimated true mean score is at most 75.

b. The manager should not worry since the estimated true mean score is at most 75.

c. The manager should worry since the estimated true mean score is higher than 75.

d. The manager should not worry since the estimated true mean score is higher than 75.

14. Suppose you wish to estimate the proportion of patients with cough whose conditions improved after taking regulated doses of a herbal treatment with 99% confidence such that the difference between the true proportion and the estimate is at most 3%. What is the minimum sample size required?

    a. 1068   c. 1842

    b. 1509   d. 1849

15. A 95% confidence interval for the proportion of Filipino adults who watch billiards whenever it is shown on TV is [0.0647, 0.0953]. Which of the following is/are true?

a. A point estimate of the proportion of Filipino adults who watch billiards whenever it is shown on TV is 0.08.

b. You are 95% confident that the percentage of Filipino adults who watch billiards whenever it is shown on TV is from 6.47% to 9.53%.

c. The proportion of Filipino adults who watch billiards whenever it is shown on TV has changed since it was found that the proportion was 0.18 in the previous year.

d. all of the above

16. Eight volunteers were asked to perform a simple task under both the normal and stressful conditions. Under the stressful condition, a mild shock was delivered to the volunteers 3 min into the experiment and every 30 s thereafter until the task was completed. Blood pressure readings were taken at both times. The data below represent the highest readings during the experiment.

Volunteer	1	2	3	4	5	5	7	8
Normal	126	117	115	118	118	128	125	120
Stressful	130	118	125	120	121	125	130	120

    A 95% confidence interval will be constructed to determine if the data provide sufficient evidence to indicate higher mean blood pressure readings under the stressful condition. Assuming that

blood pressure readings follow the normal distribution, which formula of the margin of error should be used?

a. $e = Z_{\alpha/2}\sqrt{\dfrac{\sigma_1^2}{n_1} + \dfrac{\sigma_2^2}{n_2}}$

b. $e = t_{\alpha/2\ (n_1 + n_2 - 2)}\sqrt{s_p^2\left(\dfrac{1}{n_1} + \dfrac{1}{n_2}\right)}$

c. $e = t_{\alpha/2\ (v)}\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}$

d. $e = t_{\alpha/2\ (n-1)}\dfrac{s_d}{\sqrt{n}}$

For numbers 17 and 18, consider the following.

A study was conducted to determine the effect of nutrition on the attention spans of elementary school pupils. A group of 20 pupils were randomly assigned each to one of two meal plans: no breakfast and full breakfast. Their attention spans (in minutes) were recorded during a morning reading period and are summarized below.

Statistic	Meal Plan	
	No Breakfast	Full Breakfast
Mean	39	43
Standard Deviation	1.03	1.09

Suppose that attention spans for the two meal plans follow the normal distribution with equal population variances.

17. What is the estimate of the unknown common variance of the attention span for the two meal plans?
   a. 1.0296
   b. 1.0600
   c. 1.0604
   d. 1.1245

18. A 95% confidence interval for the difference between the true mean attention spans of the two meal plans is from –5 to –3 min. Is there a significant difference between the mean attention spans of the two meal plans?
   a. No, since 0 is included in the confidence interval.
   b. Yes, since 0 is included in the confidence interval.
   c. No, since 0 is not included in the confidence interval.
   d. Yes, since 0 is not included in the confidence interval.

19. Do men enter married life at an older age than women? A random sample of 10 marriage certificates obtained from an Office of the Civil Registrar showed that women settled down at an average age of 22 while their grooms tied knots with their brides at an average age of 27. Assume that the distribution of marrying ages for both females and males is normal. Which of the following is true about the tabular value needed in constructing a 95% confidence interval for the difference between the true mean marrying ages of females and males?
    a. $Z_{0.025} = 1.96$
    b. $t_{0.025(18)} = 2.101$
    c. $t_{0.025(9)} = 2.262$
    d. cannot be determined

20. Recent surveys have shown that more Filipinos are now actively participating in environmental protection programs, with most of them engaged in recycling, tree planting, and waste segregation. An environmental group wanted to determine if this active involvement to environmental protection takes place in both urban and rural communities. Random samples of 100 Filipinos each from both the urban and rural communities were asked about their involvement. Results showed that 64% and 60%, respectively, of those interviewed were actively involved in environmental protection programs. A 95% confidence interval for the difference between the true proportions of Filipinos actively involved in environmental protection programs from the urban and rural communities is between –0.1152 to 0.1552. Which of the following is/are true?
    a. There is no significant difference between the proportions of Filipinos in urban and rural communities who are actively involved in environmental protection programs.
    b. The difference between the proportion of Filipinos actively involved in environmental protection programs from the urban and rural communities is not significantly different from zero.
    c. The proportion of Filipinos in urban communities who are actively involved in environmental protection programs is equal to the proportion of Filipinos in rural communities who are actively involved in environmental protection programs.
    d. all of the above

Chapter Workout

Do as indicated.

1. The following data represents the population of top five best-selling video games of all time.

Rank	Game	Games Sold (millions)
1	Wii Sports	47
2	Super Mario Bros.	40
3	Pokemon Red/Green/Blue	31
4	Tetris	30
5	Duck Hunt	28

Source: TIME for Kids Almanac 2011

a. Compute the mean μ and variance σ^2 of the number of games sold of the top five best-selling video games of all time.

b. A random sample of size 3 is taken from the population of top five best-selling video games of all time. List all possible samples of size 3 that can be drawn from this population using sampling without replacement. Compute the $\bar{x}$ for each of the sample.

Sample Number	Sample	Sample Mean, $\bar{x}$
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

c. Construct the sampling distribution of $\bar{x}$. Find its mean and variance.

Sampling Distribution of $\bar{x}$

$\bar{x}$										
$p(\bar{x})$										

d. Compare the mean and variance of the sampling distribution of $\bar{x}$ with the mean μ and variance σ^2 of the population.

2. The gestation period of humans follows a normal distribution with a mean of 266 days and a standard deviation of 16 days.
   a. Find the probability that a random sample of 15 pregnancies has a mean gestation period of 260 days or less.

   b. Solve for the probability that a random sample of 20 pregnancies has a mean gestation period of 260 days or less.

   c. Explain the possible effect of increasing the sample size on the probability.

   d. Find the probability that a random sample of 16 pregnancies has a mean gestation period between 262 and 272 days.

   e. Find the probability that a random sample of 36 pregnancies has a mean gestation period within 5 days of the mean.

3. Automotive engineers have found that the gas mileage in highway driving of a certain sports utility van is normally distributed with a mean of 13.6 kilometers per liter and a standard deviation of 1.5 kilometers per liter.
   a. Find the probability that a random sample of 20 sports utility vans has a mean exceeding 14 kilometers per liter.

   b. Find the probability that a random sample of 30 sports utility vans has a mean exceeding 14 kilometers per liter.

c. Explain the effect of increasing the sample size on the probability.

d. Find the probability that a random sample of 16 sports utility vans has a mean between 13.2 and 14.2 kilometers per liter.

e. Solve for the probability that a random sample of 25 sports utility vans has an average within 0.5 kilometer per liter of the mean.

4. A nutritionist claims that children 13 to 15 years old are consuming less than the recommended iron intake of 20.5 mg.
   a. To test the nutritionist's claim of iron deficiency, a random sample of children 13 to 15 years old will be obtained. Assume that the data for iron intake follows the normal distribution with a standard deviation of 4.75 mg. Find the size of the sample that you should take if you want to estimate the true mean iron intake to within 1 mg with 99% confidence.

   b. Due to financial constraints, a random sample of 50 children 13 to 15 years old was obtained instead, and their daily consumption of iron was measured. The mean daily iron intake among these children was found to be 12.5 mg. Construct a 95% confidence interval for the true mean iron intake among children 13 to 15 years old. Interpret your results.

   c. From the results in (b), is there an evidence to support the claim of the nutritionist? Justify your answer.

5. Trends in fashion have signaled the emergence of green as the color of the century. It ranked third as the most preferred color among designers having a market share of 9.24%. Its popularity may be partially due to an increased interest in the environment. Besides, "Green symbolizes harmony and counteracts emotional stress."
   a. To verify the accuracy of these figures, a survey is being considered. Find the size of the sample that you should take if you want the estimate of the true proportion of designers who preferred green not to differ by more than 0.03 with 95% confidence.

   b. Due to financial constraints, only a random sample of 250 local designers were interviewed and asked about their preferred color. Results showed that 27 preferred the color green. Construct a 95% confidence interval for the true proportion of local designers who preferred the color green. Interpret your results.

   c. From the results in (b), is there a sufficient evidence to indicate that the proportion of local designers who preferred the color green is different from 9.24%? Justify your answer.

6. A professor suspects that where a student is seated in the classroom affects his overall grade point average (GPA). He/She randomly selected 10 students from each of the two seat locations: front and back. Their GPAs were as follows.

Front	3.559	3.332	2.690	3.575	3.894	3.062	2.966	3.400	3.523	3.885
Back	2.653	3.060	2.598	2.926	2.646	2.583	3.090	2.463	2.879	3.221

Suppose the GPAs for the two seat locations are known to follow the normal distribution with unequal population variances.

a. Construct a 95% confidence interval for the difference in the true mean GPAs of students seated in front and at the back of the classroom. Interpret your results.

b. From the results in (a), is the mean GPA the same for the two seat locations? Justify your answer.

7. Leonardo da Vinci, a scientist and an artist at heart, used to draft instructions for other artists on how to proportion the human body both in painting and in sculpture. One of his rules was that the height of a person must be equal to the span of his outstretched arms. To test how real this claim is, a random sample of 12 students was taken, and their heights and arm spans (in centimeters) were measured. The results are as follows.

Student	1	2	3	4	5	6	7	8	9	10	11	12
Height	156	153	164	160	157	158	165	161	181	167	167	168
Arm Span	156	156	164	156	162	166	166	167	192	167	167	169

Suppose the differences in the measurements follow the normal distribution.

a. Construct a 99% confidence interval for the difference between the true mean height and arm span. Interpret the results.

b. Does the result in (a) support da Vinci's rule? Justify your answer.

8. An assembly operation in a manufacturing plant requires a one-month training period for an employee to reach maximum efficiency in assembling a device. To study the effectiveness of this training, a random sample of 9 new workers was selected. The length of time (in minutes) it took each employee to assemble the device was recorded before and after the training, and are presented below.

Worker	1	2	3	4	5	6	7	8	9
Before	47	45	42	42	45	44	46	43	43
After	24	26	25	26	23	25	24	25	23

Suppose the differences in the length of time required to assemble the device before and after the training follow the normal distribution.
   a. Construct a 95% confidence interval for the difference in the true mean length of time required to assemble the device before and after the training. Interpret the results.

   b. From the results in (a), does the data provide sufficient evidence to indicate that the training is effective? Justify your answer.

9. A new method of training has been suggested to better improve an employee's efficiency in assembling a device. A study was conducted to compare this new method with the standard training procedure. Two groups of eight new employees were trained for one month, one group following the new method and the other

following the standard training procedure. The length of time (in minutes) required for each employee to assemble the device was recorded at the end of the training period and presented below.

Procedure	1	2	3	4	5	6	7	8
Standard	22	26	25	23	24	25	24	26
New	25	29	25	28	26	29	26	27

Suppose the lengths of time it took to assemble the device for the two training procedures follow the normal distribution with equal population variances.

a. Construct a 95% confidence interval for the difference between the true mean length of time required to assemble the device under the standard and the new training procedures. Interpret the results.

b. From the results in (a), does the data provide evidence to indicate that the mean time an employee can assemble the device is less for the new training procedure? Justify your answer.

10. When you send an e-greeting card, do you always look for a humorous card? A provider of e-greeting cards hinted a slight difference in the proportions of humorous cards sent for two occasions: birthdays and Valentine's Day. To validate this observation, random samples of 500 birthday and Valentine's Day e-greeting cards sent were selected from a database and their designs determined. The following table shows the result.

Occasion	Design		Total
	Humorous	Not Humorous	
Birthday	100	400	500
Valentine's Day	125	375	500

a. Find a point estimate of the difference between the proportions of birthday and Valentine's Day cards that are humorous.

b. Construct a 95% confidence interval for the difference between the true proportions of birthday and Valentine's Day cards that are humorous. Interpret the results.

c. From the results in (b), does the data provide evidence to indicate a difference between the proportions of birthday and Valentine's Day cards that are humorous? Justify your answer.

11. The manager of a campus bookstore wants to investigate if a difference exists between the proportion of male and female students who purchase the prescribed textbook in statistics. Random samples of 300 male and female students enrolled in a course in statistics were asked if they purchased the prescribed textbook. The results are summarized in the following contingency table.

Purchased Textbook in Statistics	Gender	
	Male	Female
Yes	130	150
No	170	150
Total	300	300

a. Find a point estimate of the difference between the true proportions of male and female students who purchased the prescribed textbook in statistics.

b. Construct a 99% confidence interval for the difference between the true proportions of male and female students who purchased the prescribed textbook in Statistics. Interpret the results.

c. From the results in (b), does the data provide evidence to indicate a difference between the true proportions of male and female students who purchased the prescribed textbook in Statistics? Justify your answer.